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(64) Automatic wiring station particularly for machines for preparing cut-to-size electrical wire leads fitted with insulatable electrical terminals.

(57) The automatic wiring station comprises a movable gripper (9) adapted to grip a first end of a wire lead as previously fitted with an electrical connector (20) and a pusher assembly (28) including a clamp (34-37) for clamping on the wire lead end fitted with a terminal (20) to guide it through a translatory movement toward a seat accommodating an insulating protection and subsequently toward a base (4) to be wired. The station also comprises an insulating protection feeder arranged to progressively move a protection into the path of attachment of the electrical terminal (20), a holder (50, 51) for clamping the base (4) with several connections (53, 54) to be wired, a switch-over device for pre-selecting the cross-sectional area of the electrical wire lead (23, 64, 65) combined with a station (70-72) for overprinting the ends of each wire lead length with a code, and a means of controlling and setting the operations of the machine while running.

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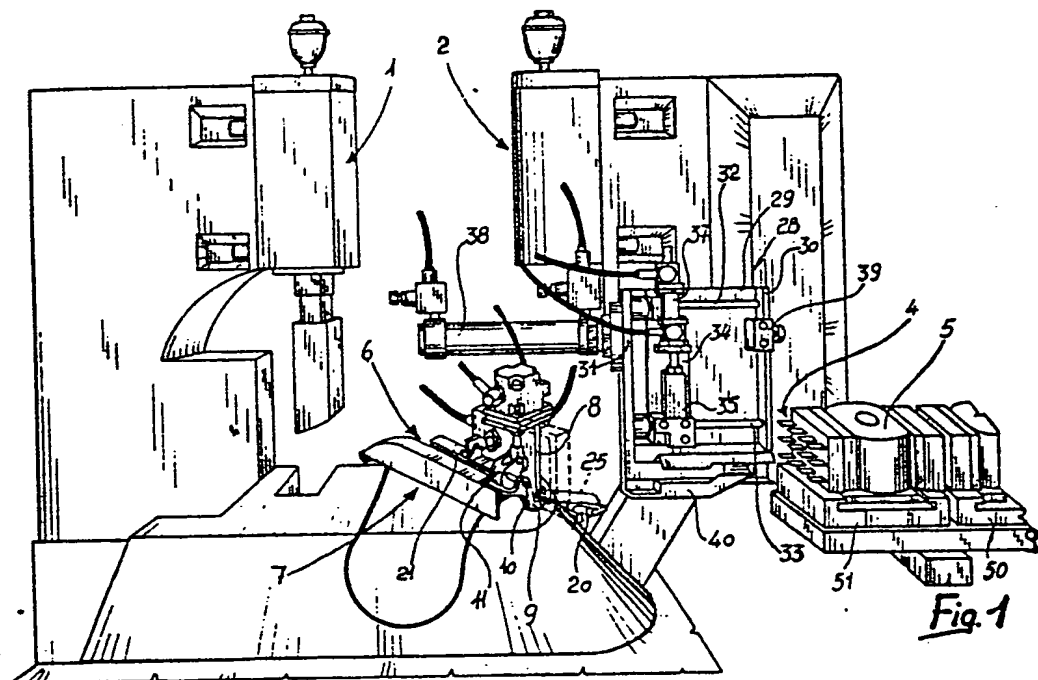


Fig. 1

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"AUTOMATIC WIRING STATION PARTICULARLY FOR MACHINES FOR PREPARING CUT-TO-SIZE ELECTRICAL WIRE LEADS FITTED WITH INSULATABLE ELECTRICAL TERMINALS"

The present invention relates to an automatic wiring station adapted for incorporation to machines used to prepare electrical wire leads cut to size and fit them with electrical terminals which may be provided with some insulating protections.

A machine of this type is disclosed in Italian Patent No. 41565 A/82 filed by the same Applicants.

That machine, which is computer controlled, enables electrical wire leads to be cut to size, whilst removing an insulator segment from both ends thereof, and fitted with electrical terminals for connection purposes, which terminals may be enclosed, if necessary, within an insulating protection.

Thus, the machine produces wire lead segments or sections which are ready for wiring bases or boards equipped with complementary connectors, the connectors associated with the bases or boards being of the "male" type, whereas the connectors fitted to the lead ends are of the "female" type.

Wiring is a time-consuming and expensive manual operation, in the course of which an operator must pay great attention not to erroneously exchange and incorrectly apply the connectors to the multiple base.

It is indeed for this reason that the leads commonly utilised for wiring a multiple base have different colours for easier identification.

It is clear why such a wiring procedure is expensive, especially where a large number of like pieces are to be prepared, as in the instance of circuit components for domestic appliances, for example.

It is an object of the present invention to provide a station as indicated, which permits a multiple base wiring operation to be rendered fully automated.

5 Another object of the invention is to provide a station for incorporation to a machine which prepares the electrical cable segments and fits them with electrical connectors, so as to complete automation of the operations for preparing pre-
10 fabricated elements for mass production electrical systems.

A further object is to provide a machine which is programmable, thereby it can select in each case, a lead of suitable cross-sectional area according to
15 whether the line is a power one or a duty or signal line.

Still another object is to provide a machine equipped with grip means adaptable to a variety of bases to be wired, said means being operative to
20 position the base for a multiple or otherwise complex wiring operation.

A not unimportant object is to provide a wiring station comprising simple, strong members, adapted to allow fast and accurate working sequences.

25 These and other objects, such as will be apparent hereinafter, are achieved by an automatic wiring station particularly for machines for preparing cut-to-size electrical wire leads fitted with insulatable electrical terminals, characterized in that it comprises:
30

a) a movable gripper adapted to grip a first end of at least one wire lead as previously fitted with an electrical connector;

5 b) a pusher assembly including a clamp for clamping on the wire lead end fitted with a terminal and being mounted on a slide provided with a blade acting on the electrical terminal to guide it in translatory movement toward a seat accommodating an insulating sheath and successively toward a base
10 to be wired;

c) an insulating sheath feeder arranged to move an insulating sheath into the path of movement of the electrical terminal;

15 d) a holder for clamping the base with several connections to be wired, mounted on a power driven double slide which allows its programmed movement on a normal plane to the path of movement of the electrical terminal associated with the wire lead end;

20 e) a switching device for pre-selecting the cross-sectional area of the electrical wire lead combined with a station for overprinting the ends of each wire lead length prepared with a code;

f) means for controlling the setting of the operations of the machine.

25 Further features and advantages of the invention will be apparent from the following detailed description of a preferred embodiment thereof, given herein by way of illustration and not of limitation with reference to the accompanying drawings, where:

30 Figure 1 is a front view of a machine for preparing

electrical wire leads showing the devices which make up the automatic wiring station according to the invention;

Figure 2 is a top plan view of the device making up the wiring station;

5 Figure 3 is a front view of the gripper device for gripping the wire;

Figure 4 is a partly sectional view of the pusher assembly and system for feeding the insulating portion of the electrical connectors;

10 Figure 5 shows the clamping and positioning device for the elements to be wired;

Figure 6 is a partly sectional view of the electrical cable feeding station showing the cable switching and sorting device;

15 Figure 7 is a partly sectional view of the front portion of the switching and sorting device for the electrical lead.

With reference to the cited drawing figures, the wiring station of this invention is particularly adapted for co-operation with a machine for stripping insulating sheath from an end of a piece of wire and clinching a terminal thereto which comprises two clinching stations formed of two presses 1 and 2, respectively, as shown in Figure 1.

25 This machine, as already discussed and claimed in the cited prior patent application, is programmed to cut an electrical wire lead to size and strip its end of the insulator over an appropriate length, that stripped end is then fitted with an electrical terminal
30 by the intervention of two presses indicated in Figure 1

by the reference numerals 1 and 2.

The invention relates to a further station, particularly for co-operation with that machine, which effects the automatic and programmed wiring of a multiple connector base indicated at 4 in Figure 1 and belonging, for example, to a timer 5 for a domestic appliance.

Provided at the station is a rotatable base 6 which may be rotated by conventional actuation means such as motor or an appropriately mounted hydraulic piston, the base 6 carries a turret generally indicated at 7 which has a supporting plate 8 extending substantially in a vertical plane and supporting all of the turret members.

As shown clearly in Figure 3, these members comprise a shoulder 18 associated with the supporting plate 8 and including a seat 18a adapted for accommodating a portion of the circumference of a wire to be gripped thereon by a gripper 9, including a mouth 9a, shaped to substantially envelop the shoulder 18 to grip a wire therebetween. The gripper 9, is journaled by a pin 10 to a bracket 10a rigidly associated with the supporting plate 8 and defining a double lug or yoke 11, penetrated by a second pin 12 which fits slideably into a seat 13 on an enlarged head 14 rigid with the free end or piston rod 15 of a small pneumatic control cylinder 16, mounted on the supporting plate 8.

Operation of the small cylinder 16 to cause movement of the piston rod 15 in an upward direction, results in a movement of the gripper 9 to a closed

position, by causing pivotal movement of the yoke 11 in a clockwise direction about the pin 10 and hence, inward sliding movement of the second pin 12 in the seat 13 as the enlarged head 14 is raised, resultantly causing the mouth 9a of the gripper 9 to move towards the shoulder 8a, thereby blocking the wire lead 17 against the shoulder 18 associated with the supporting plate 8. Conversely, the gripping force imposed upon the wire 17 is releasable by actuating the cylinder 16 to cause the piston rod 15 to move in a downward direction.

The station mounted on the turret 7 is also provided with a deflector 19 which, when in its closed position, guides the head of the wire fitted with the terminal 20 into the gripper 9, which would be open, and when the latter is closed, pivots on a hinge 21 under control by a second small double-acting pneumatic cylinder 22 to let the wire 3 run therethrough without interfering.

As shown best in Figure 2, the deflector 19 has a curved advancement face, indicated at 24 and lying rectilinearly in the zone 19 wherealong the wire can be easily advanced and deviated or deflected in its course towards the means present on the turret 7. upon the wire being advanced, the turret 7 occupies the position indicated at A in dash lines.

In this condition, the wire, now indicated at 23, is led by the curved region 24 of the deflector door 19 into the gripper 9.

That end of the wire 23 which is provided with the terminal 20 projects by a suitable length from

the gripper 9 and is inserted into a guide channel 25 journaled in the proximity of the gripper 9 and being held at an aligned position by a spring, not shown.

5 The guide channel 25 serves the purpose of orienting the electrical terminal 20 in a correct position.

Upon the gripper 9 gripping the wire 23, the movable base 6 is rotated into the position indicated at B in Figure 2, as shown in solid lines.

10 In this position, the rotatable base 6 and hence deflector door 19 is pivoted through about 90° so as to not act on the wire, now indicated at 26, thereby the wire can run through until its second end, indicated at 27, is caught in a second gripper device indicated at 28 of a known type, and as already illustrated in
15 the cited prior Italian Patent No. 41565 A/82.

In this position, the electrical connector is now positioned at the area of the insertion pusher, generally indicated at 28.

20 Said insertion pusher assembly 28 comprises a vertical plate 29 made fast with the machine frame 100 which supports two side frames 30 and 31 between which are two cylindrical guides 32 and 33 which function as supports for a slide 34 which carries a vertical rod 35 formed, at its bottom portion, with a yoke 36 which
25 is adapted to grip the lead 26 at the clinching area of the terminal 20.

Operation is ensured by a small double-acting vertically moveable piston 37 also mounted on, and adapted for moving the slide 34, and the rod 35.

30 A further air-operated piston 38 translates the

slide 34 horizontally between two end positions between the two side frames 30 and 31.

5 A conventional adjustable travel end stop 39 enables the full forward position of the slide 34 to be adjusted.

10 With the turret at the position B, the terminal 20 is located within a guide channel 40 formed by a bearing base 41 and a cover 42 journaled at 43 to be opened and closed by the yoke 36 whose shank 44 is passed through a slot 45 formed in the cover 42.

15 The slot 45 extends over a length equal to the full stroke excursion of the slide 34 so as to allow the cable 26 to be held firmly while the terminal 20 is being moved forward during the slide translatory movement.

20 From this position B, the guide channel 25, by interfering with the base 41, assumes a position indicated at 46 in Figure 2, releasing the terminal 20 after guiding it to the correct position within the second guide channel 40.

25 At the front portion of said second guide channel 40 there are fed in from a side slot insulating caps 46 which are gravity fed from an inclined feed-in chute 47, in co-operative communication with a vibrating orientator device which may, for example, comprise a helically hollowed ramp wherealong the caps are caused to advance by vibrating the same. The ramp element being cylindrical, and at a predetermined point, the caps may be caused to fall therefrom, before re-
30 commencing their advancement until they assume correct

orientation.

5 In this condition, an insulating cap 48 would
be inserted into the foremost portion of the second
guide channel 40, thereby as the terminal 20 moves
forward under the thrust applied by the piston 38 or
by translation of the slide 34, there first occurs
the insertion of the terminal into the insulating cap
and then, with a further forward movement, the ter-
10 minal is inserted into a male connector 49 on a base
4 belonging, for example, to a timer 5 which is previously
positioned as a direct continuation of said second
guide channel 40, which is mounted on the rotatable
table 52, positionable in combination with two motors
56,58, adapted for causing movement of the table 52
15 in vertical and horizontal planes respectively, according
to instructions programmed into a computer or processor
for piloting the machine.

With this operation, the lead 26 is wired to the
base 4.

20 For each lead being prepared, there will correspond
a displacement of the base 4 to bring one of the male
terminals to the proper position for the insertion of
the terminal.

25 To achieve this, there is provided a double clamping
holder, respectively indicated at 50 and 51 in Figure 1,
mounted on the rotary table 52 which enables securement
of two devices to be wired, respectively indicated at
53 and 54.

30 With the double clamping arrangement mounted on
the rotary table 52 until there occurs the wiring of

the device 53 the operator can disassemble the second device already wired and replace it with another which will be wired on the next operation.

5 The rotary table 52 is mounted on a vertical translating support 55 which is driven by a step motor 56 which allows for the vertical displacements for proper positioning in this direction of the base with respect to the second guide channel for the terminal.

10 That vertical translating support 55 in conjunction with its motor 56 is mounted on a horizontal translating support 57, also equipped with a step driving motor 58.

The combination of this device allows, therefore, the progressive positioning of the male connectors present on the devices to be wired in front of the insertion device.

The whole assembly is mounted on the machine frame.

20 All of these operations are operatively dependent on a control system with processor not shown in the figures which controls the length of the wire being cut, the insertion of the terminals and insulating caps, and the positioning of the base to be wired at the correct position.

25 In many wirings of the industrial type for reasons of economy, it is convenient to use two types of wire, a first wire of larger cross-section for transferring electrical power, and a second type of wire having a thinner cross-section for transferring signals or information.

30 Figures 6 and 7 illustrate the device which

performs the feeding and selection of a wire cross-section sought.

5 The device for feeding and selecting the type of wire to be employed shown in Figure 6 consists of four feeding rollers of which two are indicated and visible in the figure which shows a section through the device itself where they are indicated at 59 and 60.

10 The feeding rollers which are disposed in two consecutive pairs are driven through a pair of gears 61 and 62, respectively, which are in mesh engagement with a single middle pinion gear 63. The pinion 63 is actuated by the gears 61, 62, which in turn actuate two other gears, not indicated in the drawings. The advancement device is leaflet No. TSA2E of INARCA S.p.A.
15 of Padova, Italy.

In Figure 6, there are indicated the two rollers 59 and 60 which are, of course, but a part of the two roller pairs providing for the wire feeding movement.

20 In the device illustrated, there are used two wires, respectively with larger cross-section 64 and smaller cross-section 65.

These two wires are inserted into two longitudinal guide grooves which are disposed at the middle region with respect to the roller pairs of which are indicated
25 the 59 and 60, said two grooves being respectively indicated at 66 and 67 being both formed in a single monolithic element 68.

Said monolithic element 68 can translate vertically owing to the driving effect of a small piston 69 and
30 the stroke length of that piston 69 is such that

only one of the two grooves, either 66 or 67, will be aligned to the feeding rollers 59 and 60 thereby only one of the two wires, either 64 or 65, will be moved forward.

5 By acting then on the small piston 69 one can select which of the two wires, either 64 or 65, will be affected by the measurement and, therefore, by the lead clenching to wire it to the base.

10 Thus it becomes possible to select the wire in conformity with the current to be passed therethrough or in the instance indicated to provide a thin wire indicated in this case at 65 and having the function of carrying signals, indications, checks, surveys, and measurements, and a power wire 64 intended instead
15 for taking current to power input groups.

The wires are in all cases and always picked up from two coils of wire and have the same colour or may have therefore at the most two colours.

20 For this reason there is provided an encoding station indicated at 70 which utilises an ink writing device where ink is injected through two slots 71 and 72 formed at the passage area of the wires 65 and 64, respectively.

25 That encoding station also programmed by the processor which controls said machine enables the writing of one code on the head and tail of the lead at a suitable distance from the end point where the terminal is connected.

30 Thus in spite of the use of a single wire to form the whole wiring of the base it is possible for

the operator to have a successive indication to enable him/her to connect the wires to the members and devices for which the base is intended.

Downstream from this encoding station the wires
5 64 and 65 are guided into flexible conduits 73 and 74, respectively, which are formed from metal coils.

These flexible conduits guide the wires to the stripping and cutting station indicated at 75 and fabricated essentially in the same way as the machine
10 of the cited prior patent.

Interposed with respect to this stripping and cutting station, is a switch-over station shown in Figure 7.

At this station the wires are guided, as mentioned,
15 by the flexible conduits 74 and 73, to a double movable head generally indicated at 76, composed of a first movable clamping device 77 comprising a small piston 78 which locks the wire 65, if necessary, within the conduit by means of a presser not shown in the figure.

20 An identical second clamping device 79 is arranged below the first and also comprises a pneumatic plunger indicated at 80 which by acting on the wire 64 locks it when necessary.

The first clamping device is provided with a lug
25 with a rack 81 which meshes with a toothed pinion 82 which is engaged by a second rack 83 made fast with the second clamping device 79.

The pinion 82 is mounted on a fixed axis relatively to the machine frame, thereby the translational
30 displacement of one of the two clamping devices results

in a simultaneous and oppositely direct displacement of the other clamping device.

The translation takes place by means of a pneumatic piston 84 whose rod 85 is made fast with the first clamping device 77.

In practice by acting on said piston 84 there is produced the translation of both clamping devices 77 and 79 with selection of the wire or transferrment of the wire head into the stripping and cutting station in one instance selecting the wire 64 and in a second instance selecting the wire 65.

The translation of the clamping devices is also allowed by that the flexible conduits 73 and 74 can extend because formed from a metal coil.

The combination of all the members described allows the fabrication of an automatic wiring station which may be divided according to its functions in a wire feeding section which as mentioned enables selection of two wires according to their cross-sections and hence their current carrying capacities.

This first section is followed by a printing and encoding section where the wire is marked with a code which identifies it.

This second section is then followed by a switch-over section which enables the leading end of the selected wire to be taken into the cutting and clenching station without the second wire interfering with this operation.

On completion of the stripping, cutting and clenching operation, the lead head is taken into the

turret which is equipped with the grip and guide devices which allow the lead now provided with the terminal into the station which carries out mechanically the insertion of the terminal on the base to be wired.

5 The base is mounted on a movable support system which affords the possibility of mounting a base with multiple connectors by progressively taking each of them to a wiring position.

10 The machine is operatively fully dependent on a control and setting processor, on which all the operations and sequence of operations which the machine is to perform are preset, and as also illustrated in the explanatory leaflet No. TSA2E of INARCA S.p.A., of Padova, Italy.

15 Having then prepared the program, the machine can carry out of its own account the whole operation of cutting to size, clenching the end electrical connectors, insulating the same, inserting one end of each lead on a multiple connection base.

20 The advantages of this described part combined with those of the machine already described and illustrated in the cited prior patent, are apparent and it is evident how with a machine of this type one can fabricate in a short time and without any chance
25 for errors multiple wirings on bases with a number of leads which may be as high as desired.

The machine, once it is set, can do without the attendance of an operator excepting for intervention is the event of the machine jamming.

30 The machine is most suitable for repetitive

wiring of multiple bases in large mass production environments.

5 All of the control and actuation systems are formed, in the example shown, from mechanical means and pneumatic actuators which are particularly reliable and fast in operation.

10 It will be obvious that each member may be replaced with some other like or equivalent member while retaining the same principle of operation and hence falling within the protection scope of the same invention.

The control and command means may also be any ones, so long as they are capable of performing the machine programming, controlling, and commanding functions.

15 Also the materials used may be any ones, as may be the dimensions.

CLAIMS

1 1. An automatic wiring station on machines for
2 preparing electrical wire leads cut-to-size and fitted
3 with optionally insulated electrical terminals, charac-
4 terised in that it comprises;

5 (a) a movable gripper (9) adapted to grip a first
6 end of a wire lead (23,64,65) length as previously
7 fitted with an electrical connector (20);

8 (b) a pusher assembly (28) including a clamp (34-37)
9 for clamping on the wire lead (23,64,65) end fitted
10 with a terminal (20) and being mounted on a slide (34)
11 provided with a yoke (36) acting on the wire (23,64,65)
12 adjacently the electrical terminal (20), to guide it
13 through a translatory movement toward a seat accommodat-
14 ing an insulating protection and subsequently toward
15 a base (4) to be wired;

16 (c) an insulating protection feeder (47) arranged
17 to take progressively a protection (46) into the path
18 of attachment of the electrical terminal (20);

19 (d) a holder (50,51) for clamping the base (4)
20 with several connections (53,54) to be wired, mounted
21 on a power driven double slide (55-58) which allows
22 its programmed movement on a normal plane to the path
23 of movement of the electrical terminal (20) associated
24 with the wire lead (23,64,65) end;

25 (e) a switch-over device (59-63,66-69) for pre-
26 selecting the cross-sectional area of the electrical
27 wire lead (23,64,65) combined with a station (70-72)
28 for overprinting the ends of each wire lead length
29 with a code;

30 (f) a means of controlling and setting the operations
31 of the machine while running.

1 2. An automatic wiring station according to
2 claim 1, wherein said movable gripper (9) comprises
3 a gripper (9-14) driven by a small double-acting
4 plunger (16) and mounted on a turret (7) rigid with a
5 rotating movable base (6).

1 3. A wiring station according to claim 1, wherein
2 said movable gripper (9) comprises a grip element (9)
3 openable along a normal plane to the direction of
4 advancement of the wire (23,64,65) as previously fitted
5 with an electrical connector (20).

1 4. A wiring station according to claim 1,
2 wherein said movable gripper (9) is preceded, in the
3 direction of advancement of the wire (23,64,65), by
4 a deflector door (19) shaped to guide the wire (23,64,65)
5 into the gripper (9).

1 5. A wiring station according to claim 4, wherein
2 said deflector door (19) is hinged and openable to
3 release the wire (23,64,65) after its end is locked
4 in the gripper (9), thereby it can run freely through
5 until its second end is positioned at the second sta-
6 tion (28) for clenching a connector (20).

1 6. A wiring station according to claim 1,
2 wherein said movable gripper (9) grips the wire (23,64,65)
3 at a convenient distance from the electrical connector
4 (20), the same being in this phase contained within
5 a guide channel (25) which is open laterally, on the
6 gripper (9), thereby it can be removed by striking the
7 frame (30,3) of the pusher assembly (28), releasing
8 the wire (23,64,65) end and the connector (20).

1 7. A wiring station according to claim 1,
2 wherein said pusher assembly (28) comprises a gripper
3 member including a yoke (36) pushed by a piston (37)
4 which picks up the wire (23,64,65) upstream of the
5 electrical connector (20) locking it against the bearing
6 base (41) of a guide channel (40).

1 8. A wiring station according to claim 1,
2 wherein said pusher assembly (28) is mounted on a
3 slide (34) guided and translated to move the head of
4 the electrical wire lead (23,64,65) into the guide
5 channel (40) formed between the bearing base (41) and
6 an upper cover (42) which is openable and closeable by
7 said yoke (36) the shank (44) whereof in translating
8 is passed through a slot (45) formed on that same
9 cover (42).

1 9. An automatic wiring station according to claim 1,
2 wherein said insulating protection feeder (47) comprises
3 a chute (47) which takes the protections (46) to
4 arrange themselves progressively at the terminating
5 portion of the guide channel (40) so as to be located
6 in the path of movement of the electrical connector (20).

1 10. A wiring station according to claim 1,
2 wherein said device for clamping on the base to be
3 wired comprises a rotary table (52) with anchoring
4 devices, mounted on a vertical power driven movable
5 support (55) mounted in turn on a horizontal power
6 driven movable support (57), the combination of the
7 movements causing displacement of the base on a normal
8 plane to the path of movement of the pusher assembly.

1 11. A wiring station according to claims 1

2 characteriz d in that the movabl supports are
3 driven by step motors (56,58).

1 12. A station according to claim 1, wherein
2 said switch-over device for pre-selecting the wire
3 type comprises a feeding section with at least one
4 pair of power driven roller (59,60) between which the
5 wire to be fed (23,64,65) is inserted, said wire (23,64,65)
6 being guided at the areas interposed between the roller
7 pair (59,60), into grooves (66,67) formed in a body
8 (68) which in translating under control by a plunger
9 (69), takes a first and second wire (23,64,65) to
10 intervene between feed rollers (59,60).

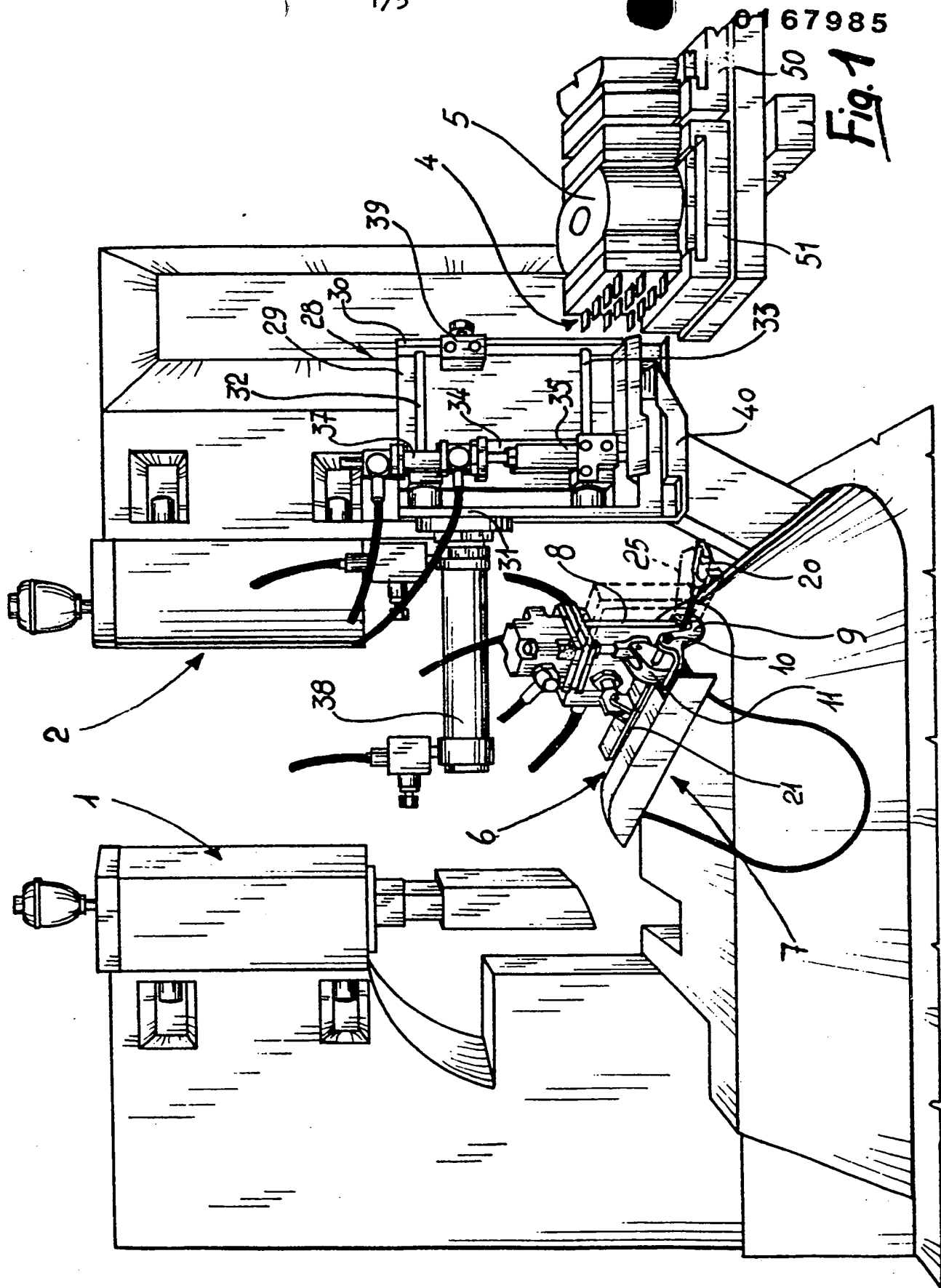
1 13. A station according to claim 12, wherein
2 each of the two grooves (66,67) wherein the wires
3 (23,64,65) are passed has a slotted opening through
4 which an encoding device (70) encodes the end of said
5 wires (23,64,65).

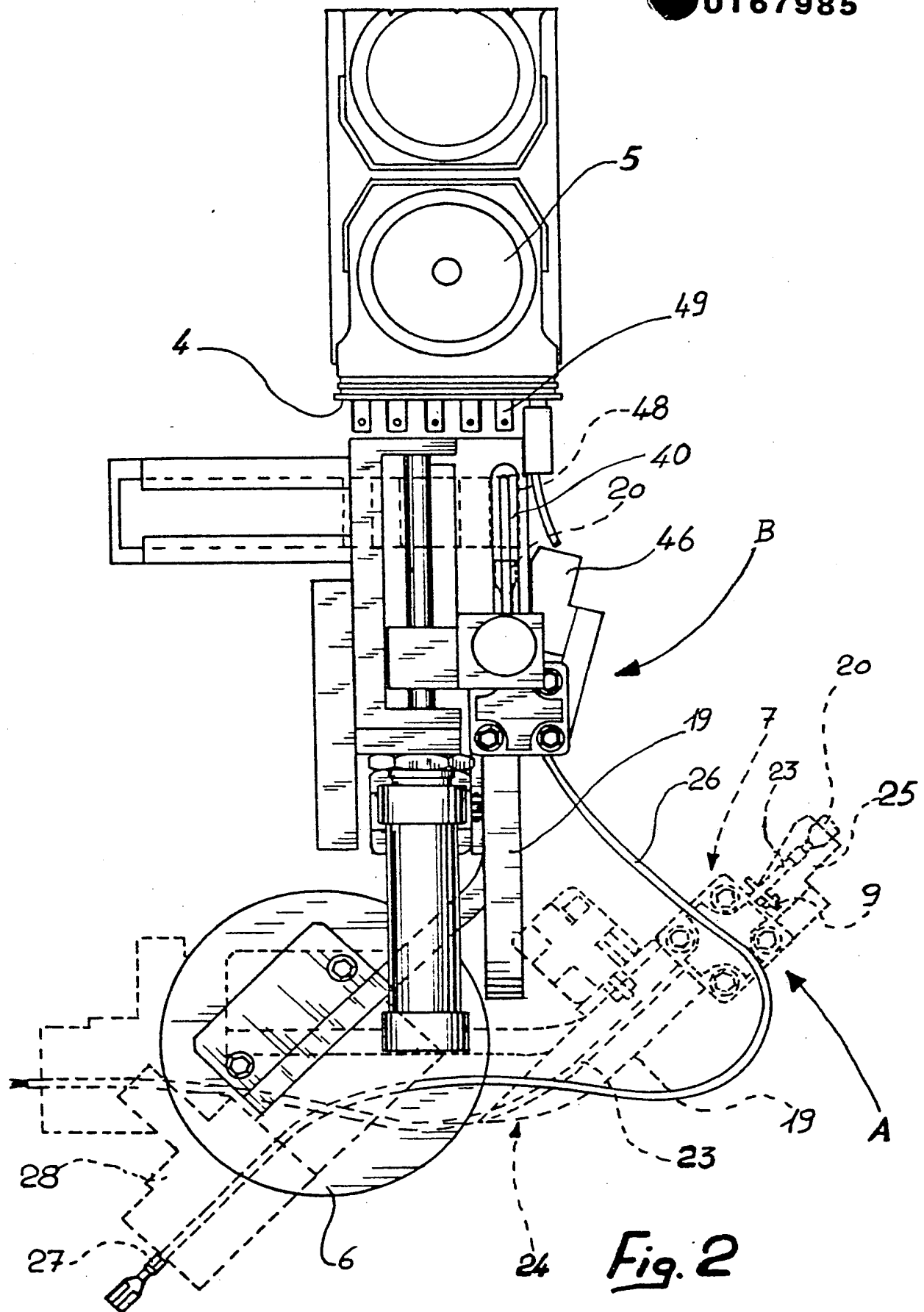
1 14. A wiring station according to claim 1,
2 wherein downstream from said feeding device wires
3 are guided by flexible conduits (73,74) adapted for
4 guiding them toward the cutting and stripping station
5 (75), said station (75) being preceded by a switch-over
6 device comprising a pair of clamping devices (77,79)
7 operative to each lock the end of one of the wires
8 (64,65), said clamping devices (77,79) being mounted
9 on moveable guides (81-83), said guides having racks
10 (81) which are adapted to be engaged by a pinion (82)
11 journaled on the machine frame (100) thereby the
12 forward movement of one first device results in the
13 simultaneous rearward movement of the second to permit

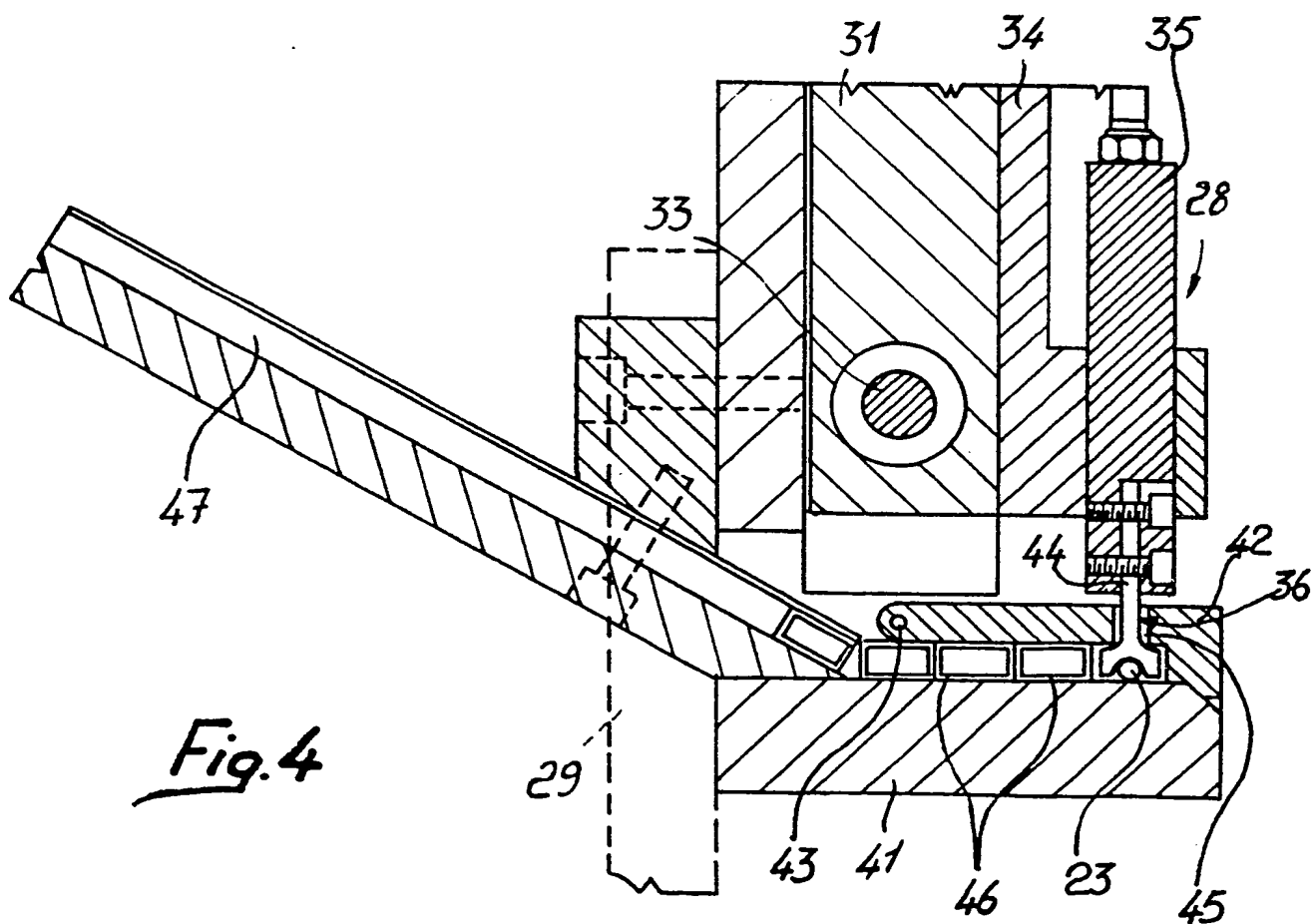
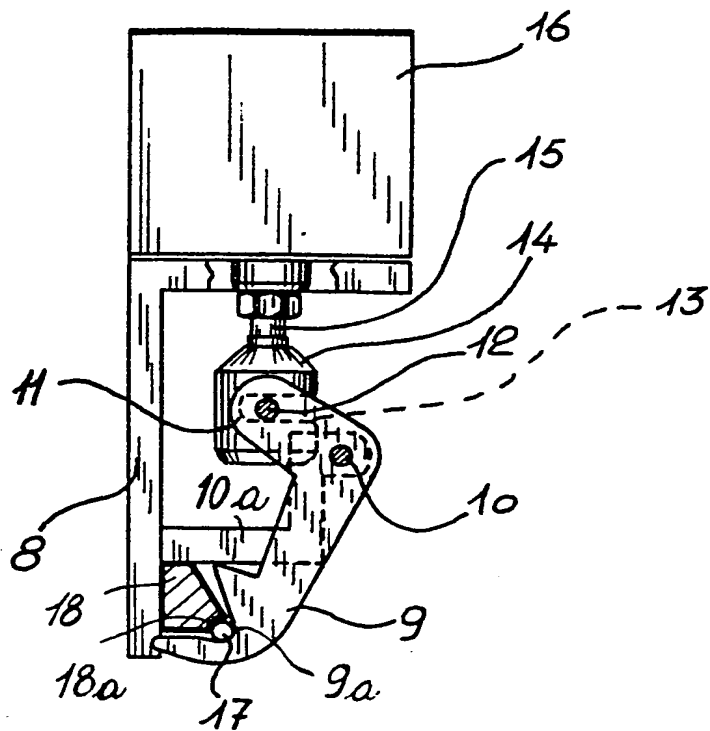
14 of the insertion without restrictions of the ends of
15 either of the wires to be cut and stripped.

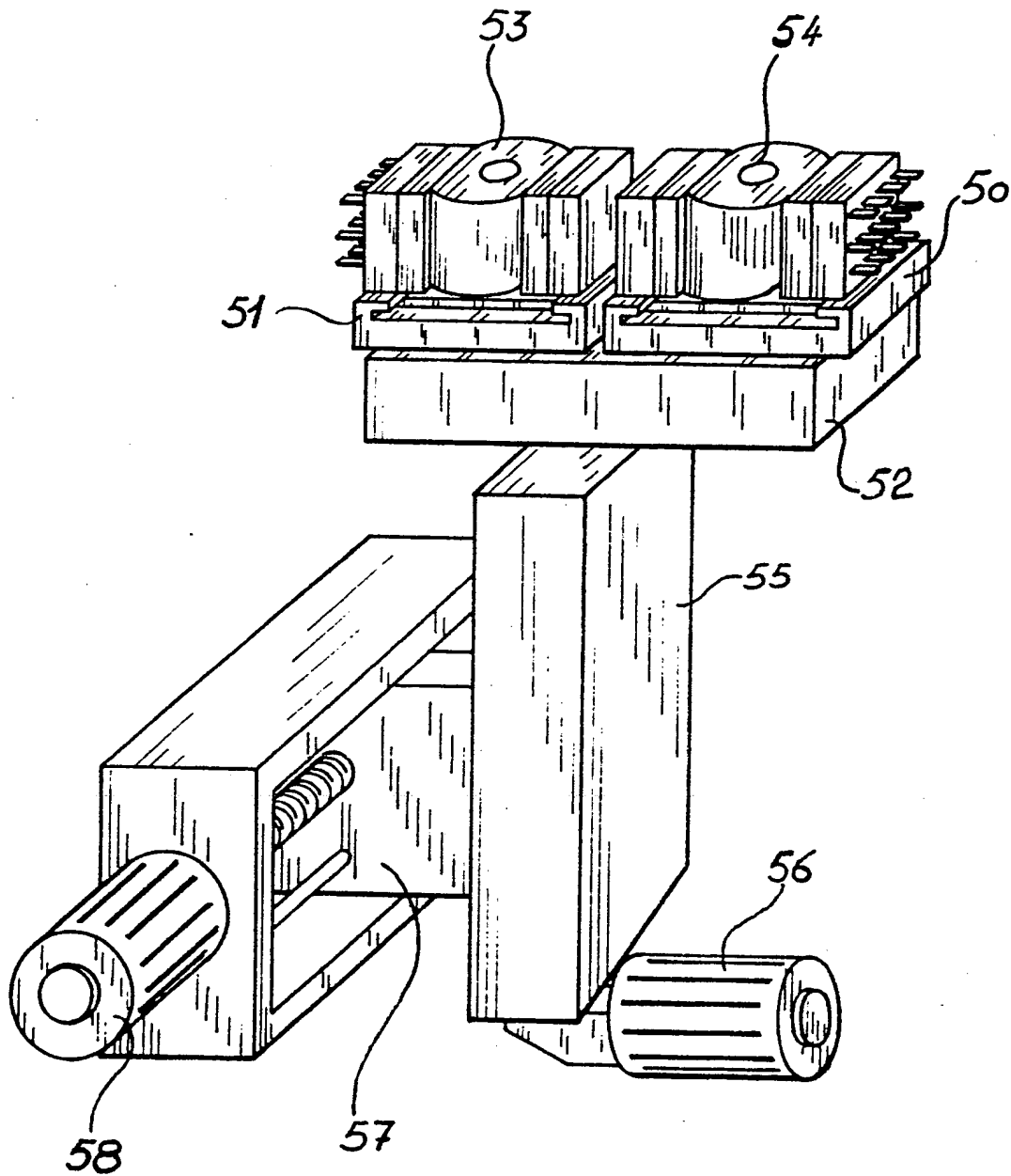
1 15. An automatic wiring station according to
2 claim 1, wherein all of the operations together are
3 controlled by a processor wherein there is set the
4 program for the functions and commands which include
5 selecting the wire (23,64,65), cutting the same to size,
6 stripping its ends, clenching electrical connectors (20)
7 on the same, insulating the electrical connectors and
8 wiring one of the wire ends to a base which is in turn
9 positioned progressively in front of the insertion station.

Fig. 1







*Fig. 5*

